

Ecological Footprint and Biocapacity Accounting:

Arab Region perspective and implications for SDG12



Global Footprint Network®
Advancing the Science of Sustainability

“Resource Efficiency in the Arab Region:
Monitoring Progress of SDG 12 and Building Back Better from COVID-19”

VISIT...

LANZAROTE
Caliente.COM

Table of Contents

Part I

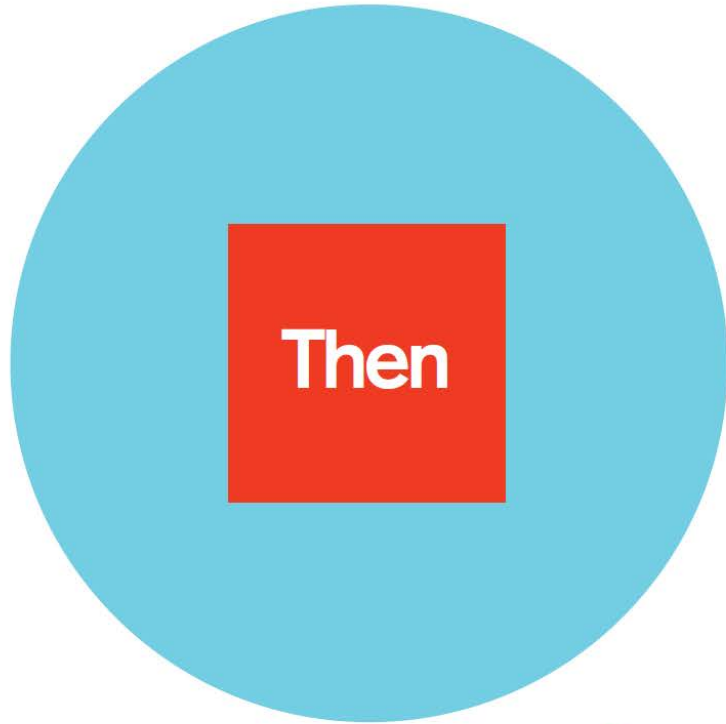
1. Premises and Accounting Principles
2. The Method: How the Metric Works

Part II

3. Results
4. Reflections: how Ecological Footprint informs SDG12



The rules of the game have changed.

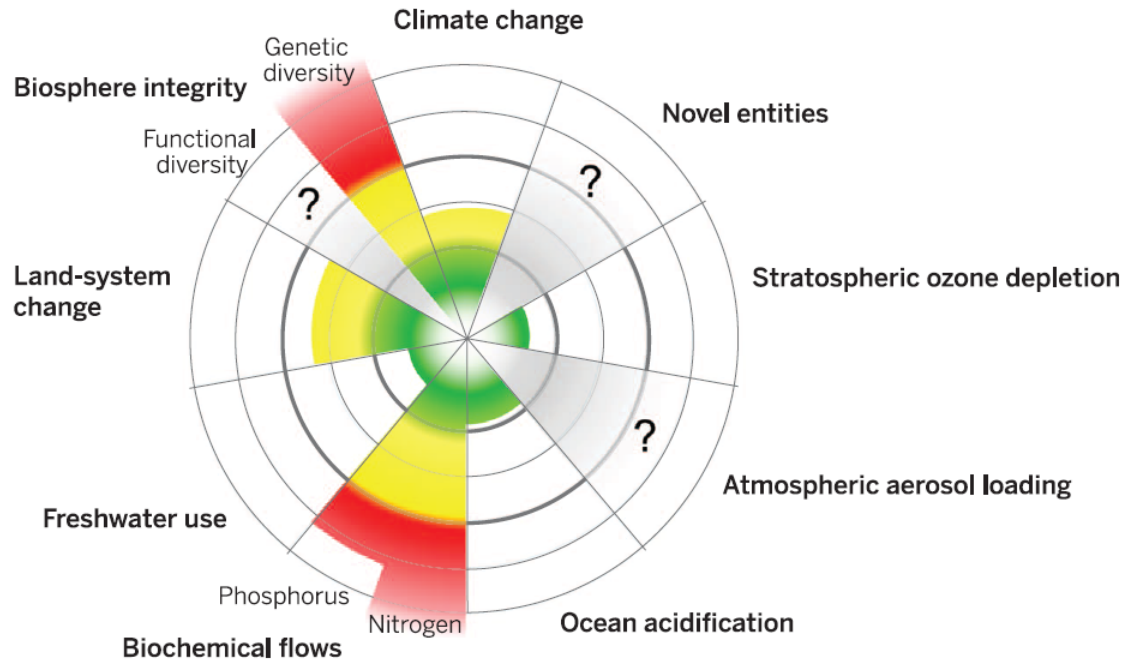


An empty world allows for unlimited production of goods.

■ Economy
● Biosphere



A full world turns the economy into a global auction.



■ Beyond zone of uncertainty (high risk) ■ Below boundary (safe)
■ In zone of uncertainty (increasing risk) ■ Boundary not yet quantified

Lots of evidence.

But how do we operationalize this?



Conditions



Outcome

climate

biodiversity

nutrients

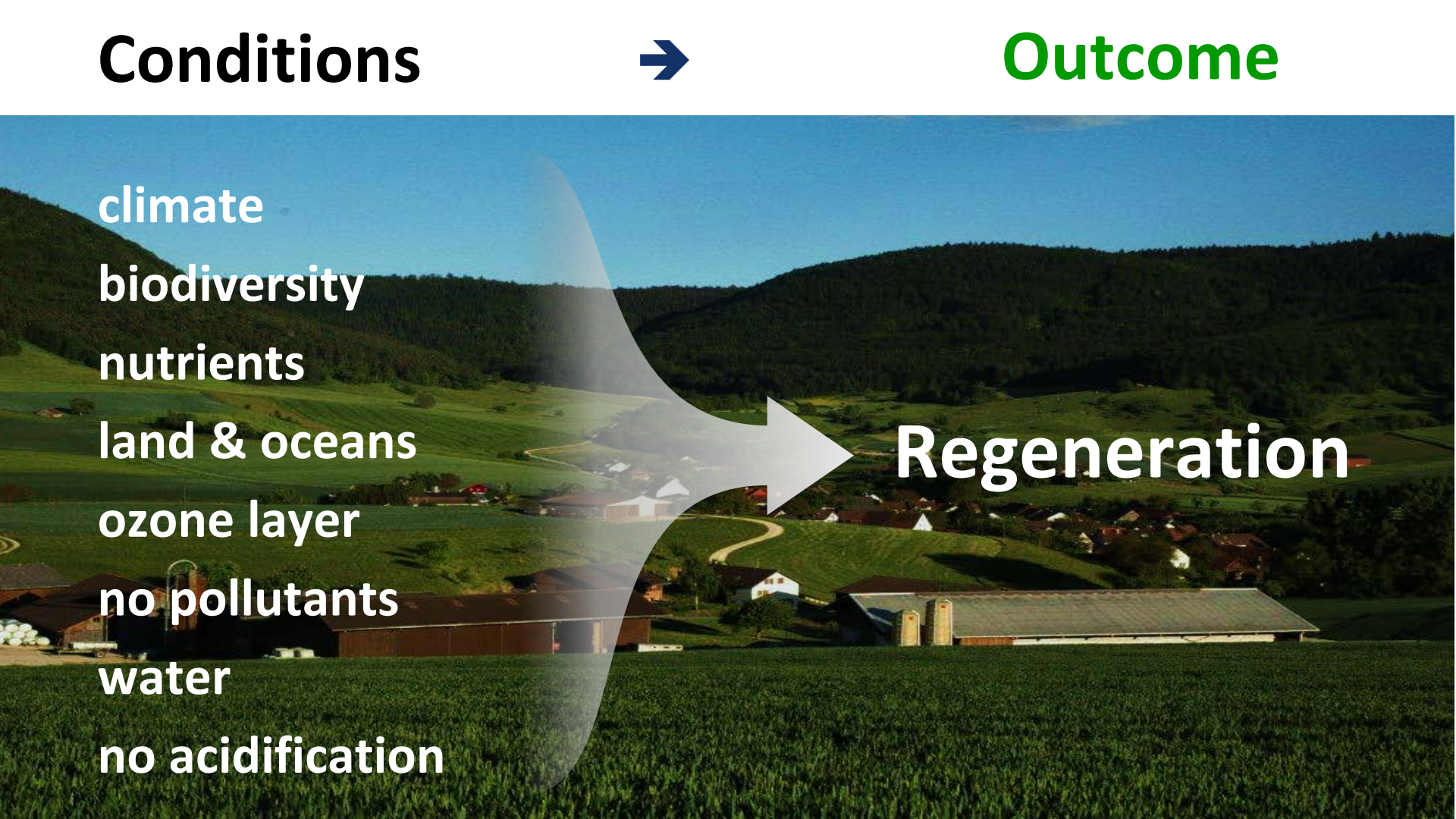
land & oceans

ozone layer

no pollutants

water

no acidification

A background image of a lush green rural landscape with rolling hills, a small village, and a large farm with silos. A large, semi-transparent white arrow points from the 'Conditions' list towards the 'Regeneration' text.

Regeneration

Access to basic living
resources underlies
every economic
activity a society can
undertake.



We call nature's regeneration “Biocapacity”

- the ability of ecosystems to regenerate plant matter (ecologists call “NPP”)
- the food source for all non-plant life
- powered by the sun
- attached to surface



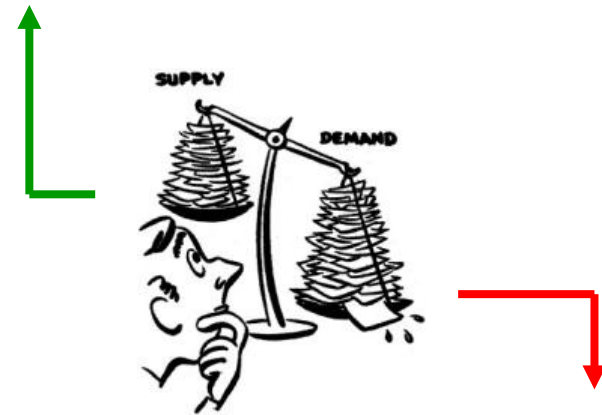
ECOLOGICAL FOOTPRINT: An Ecological Balance Sheet For Countries

The Ecological Footprint is an environmental accounting tool that identifies the extent to which human activities exceed **two types of environmental limits:**

- resource production
- waste absorption

Biocapacity:

How much bioproductive area is **available to us**?



Ecological Footprint:

How much bioproductive area do we **demand**?



NATIONAL FOOTPRINT ACCOUNTS FRAMEWORK

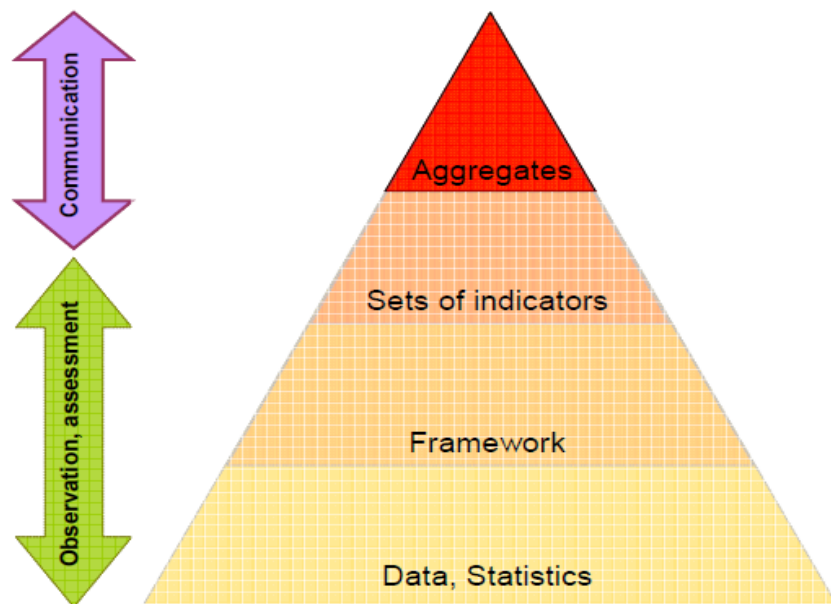


Figure 3: Pyramid structure of the National Footprint Accounts (NFA). All levels of the pyramid exist in the NFA, potentially allowing for both system's description and support to policy makers. However, data used and the framework in place are not fully consistent with SNA and SEEA (transparent colors are used here to represent this not full consistency).
Source: adapted from Weber and Martin (2009).



Outcomes: National Footprint Accounts - NFA

- **Every year** we release an updated version of the NFA, based on most up-to-date Footprint methodology and input data
- Input to the EF framework: **UN Data** (15'000 data points per country and year)
- **Each edition** tracks EF and BC values for almost 200 countries (and the World), over five decades (1961-2016) and with different level of aggregation:
 1. Aggregate national EF and BC values (most known)
 2. EF and BC values by land type
 3. EF values by variable
 4. EF values for all individual products
 5. Values are provided both per capita and total
 6. Results in both ha and gha (not for totals)
 7. Megabyte data workbook



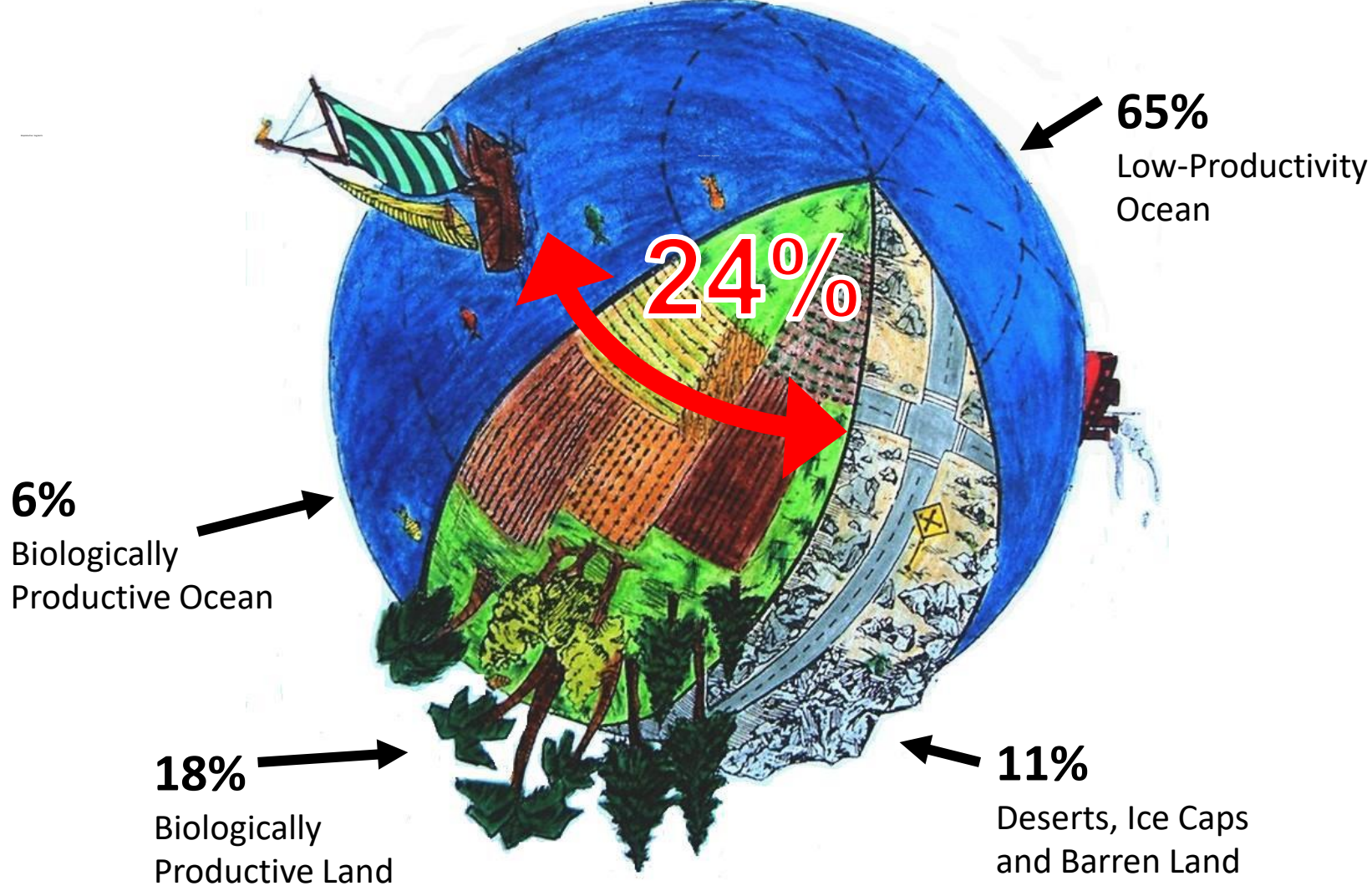
“Income” or Biocapacity

How much nature do we have?

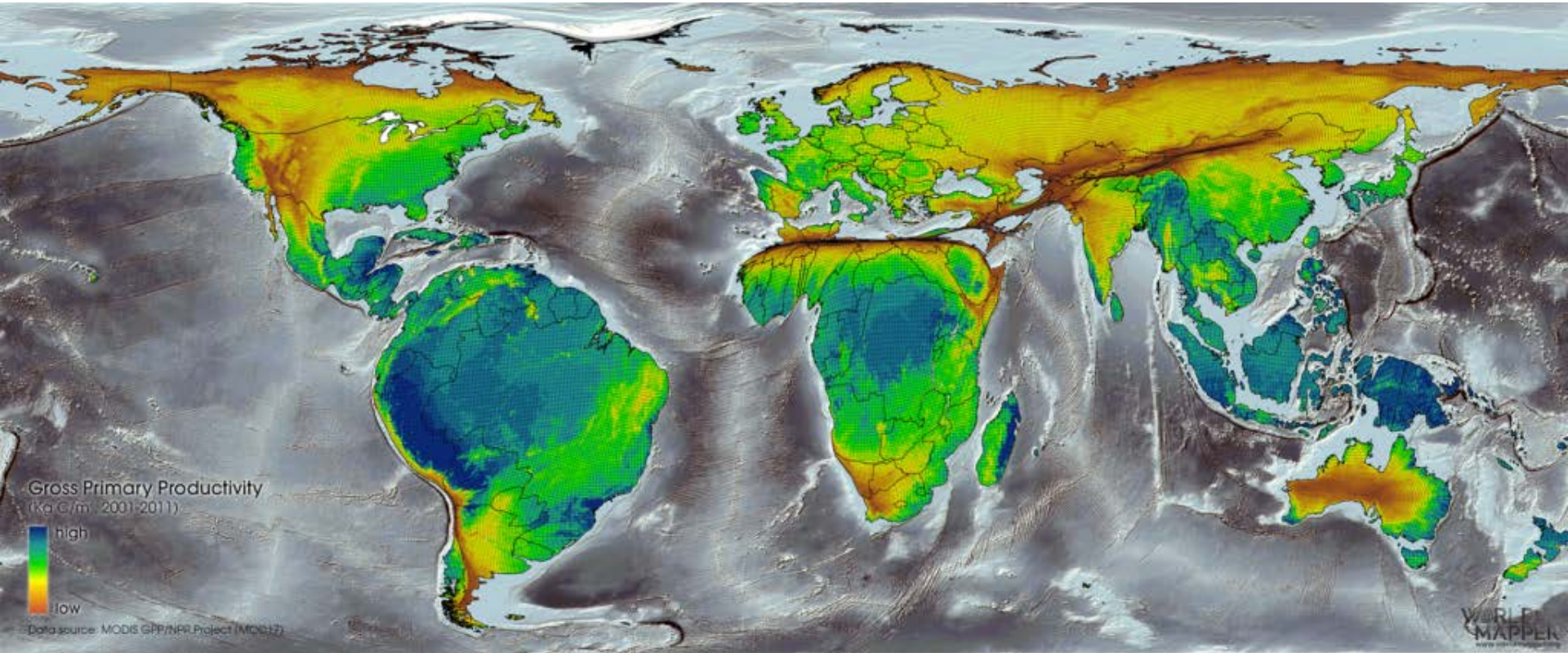
“Expenditure” or Ecological Footprint

How much nature do we use?



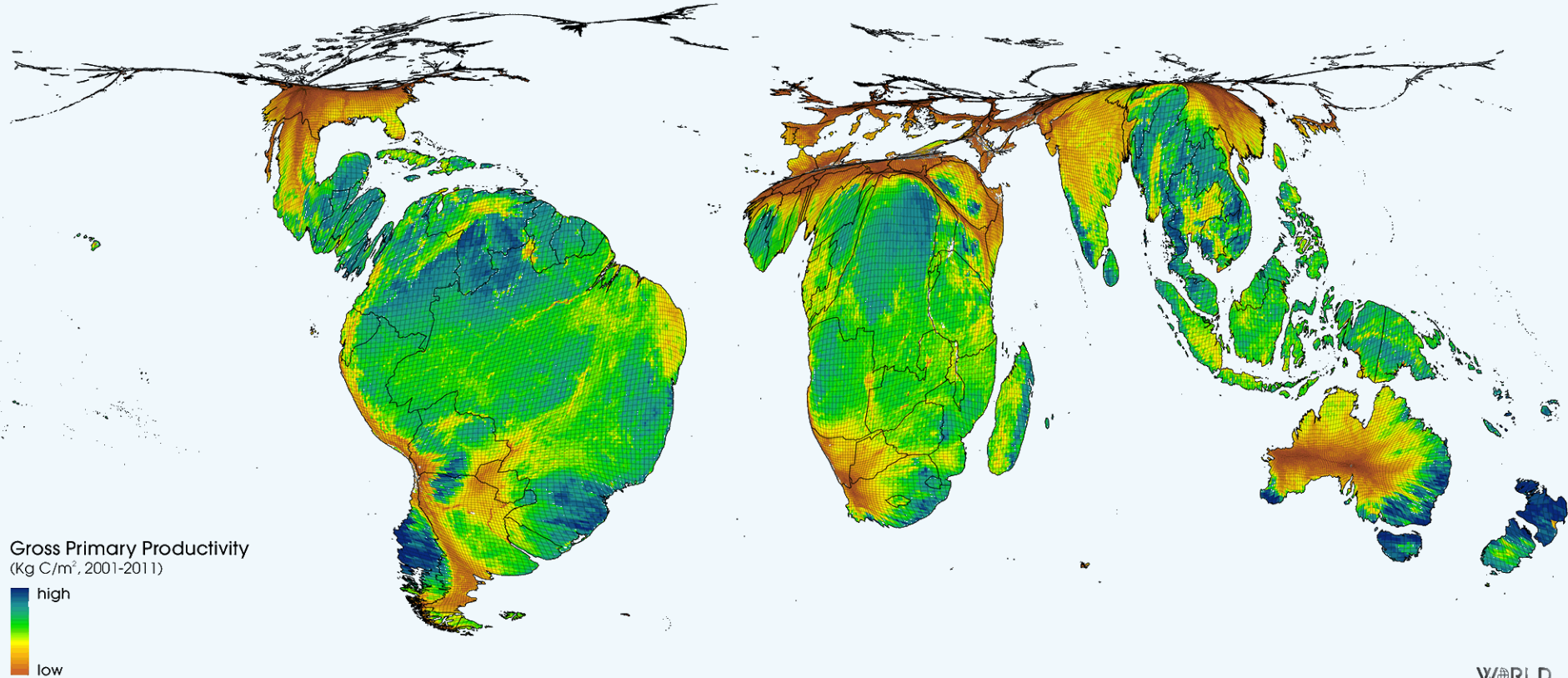


Our Planet's Biocapacity



Our Planet's Biocapacity (by month)

January



Data source: MODIS GPP/NPP Project (MOD17)

Unit: hectare-equivalent or global hectare (gha)

The Ecological Footprint is an indicator of human appropriation of Earth's photosynthetic capacity, although expressed in hectare-equivalents.

The release of 1 t of $\text{CO}_{2\text{eq}}$ does not mean that such amount is actually released (no molecule called $\text{CO}_{2\text{eq}}$). Rather, it means that various GHGs with the global warming potential of 1 t of CO_2 is released.

Similarly, an Ecological Footprint of 1 gha doesn't mean that 1 ha of physical land is used. It rather means that the capacity of 1 hectare-equivalents (or gha) is needed to produce (via photosynthesis) the renewable resources consumed and to sequester the carbon dioxide emitted



“Income” or Biocapacity

How much nature do we have?

“Expenditure” or Ecological Footprint

How much nature do we use?



Ecological Footprint Research Question

How many ecological assets are necessary to renew people's demand for:

- food, fiber, timber,
- accommodation of roads and structures,
- waste absorption: CO₂ from fossil fuel?



Dataset	Source	Description
Production of primary agricultural products	FAO ProdSTAT	Physical quantities (tonnes) of primary products produced in each of the considered countries
Production of crop-based feeds used to feed animals	Feed from general marketed crops data is directly drawn from the SUA/FBS from FAOSTAT Data on crops grown specifically for fodder is drawn directly from the FAO ProdSTAT	Physical quantities (tonnes) of feeds, by type of crops, available to feed livestock
Production of seeds	Data on crops used as seeds is calculated by Global Footprint Network based on data from the FAO ProdSTAT	Physical quantities (tonnes) of seed
Import and Export of primary and derived agricultural and livestock products	FAO TradeSTAT	Physical quantities (tonnes) of products imported and exported by each of the considered countries
Import and Export of non-agricultural commodities	COMTRADE	Physical quantities (kg) of products imported and exported by each of the considered countries
Livestock crop consumption	Calculated by Global Footprint Network based upon the following datasets: • FAO Production for primary Livestock • Haberl et al. (2007)	Data on crop-based feed for livestock (tonnes of dry matter per year), split into different crop categories
Production of primary forestry products as well as import and export of primary and derived forestry products	FAO ForeSTAT	Physical quantities (tonnes and m ³) of products (timber and wood fuel) produced, imported and exported by each country
Production of primary fishery products as well as import and export of primary and derived fishery products	FAO FishSTAT	Physical quantities (tonnes) of marine and inland fish species landed as well as import and export of fish commodities
Carbon dioxide emissions by sector	International Energy Agency (IEA)	Total amounts of CO ₂ emitted by each sector of a country's economy
Built-up/infrastructure areas	A combination of data sources is used, in the following order of preference: 1. CORINE Land Cover 2. FAO ResourceSTAT 3. Global Agro-Ecological Zones (GAEZ) Model 4. Global Land Cover (GLC) 2000 5. Global Land Use Database, SAGE, University of Wisconsin	Built-up areas by infrastructure type and country. Except for data drawn from CORINE for European countries, all other data sources only provide total area values



Dataset	Source	Description
Cropland yields	FAO ProdSTAT	World average yield for 164 primary crop products
National yield factors for cropland	Calculated by Global Footprint Network based on cropland yields and country specific unharvested percentages	Country specific yield factors for cropland
Grazing land yields	Monfreda, C., personal communication, 2008. SAGE, University of Wisconsin, Madison	World average yield for grass production. It represents the average above-ground edible net primary production for grassland available for consumption by ruminants
Fish yields	Calculated by Global Footprint Network based on several data sources including: • Sustainable catch value (Gulland, 1971) • Trophic levels of fish species (Fishbase Database available at www.fishbase.org) • Data on discard factors, efficiency transfer, and carbon content of fish per tonne wet weight (Pauly and Christensen, 1995)	World-average yields for fish species. They are based on the annual marine primary production equivalent.
Forest yields	World average forest yield calculated by Global Footprint Network based on national Net Annual Increment (NAI) of biomass. NAI data is drawn from two sources: • Temperate and Boreal Forest Resource Assessment – TBFRA (UNECE and FAO, 2000) • Global Fiber Supply Model – GFSM (FAO, 1998)	World average forest yield. It is based on the forests' Net Annual Increment of biomass
Carbon Uptake land yield	Calculated by Global Footprint Network based on data on terrestrial carbon sequestration (IPCC, 2006) and the ocean sequestration percentage (Khatriwala et al., 2009). Further details can be found in Borucke et al. (2013)	NAI is defined as the average annual volume over a given reference period of gross increment less that of neutral losses on all trees to a minimum diameter of 0 cm (d.b.h.) World average carbon uptake capacity. Though different ecosystems have the capacity to sequester CO ₂ , carbon uptake land is currently assumed to be forest land only by the Ecological Footprint methodology
Equivalence Factors (EQF)	Calculated by Global Footprint Network based on data on land cover and agricultural suitability Data on agricultural suitability is obtained from the Global Agro-Ecological Zones (GAEZ) model (FAO and IIASA, 2000) Land cover data drawn from the FAO ResourceSTAT database	EQF for crop, grazing, forest and marine land. Based upon the suitability of land as measured by the Global Agro-Ecological Zones model



The Ecological Footprint is a flows indicator, though it is measured in terms of the bioproductive land areas needed to generate such flows (expressed in the unit of global hectares - gha).

$$EF = \frac{P}{Y_N} \cdot YF \cdot EQF$$

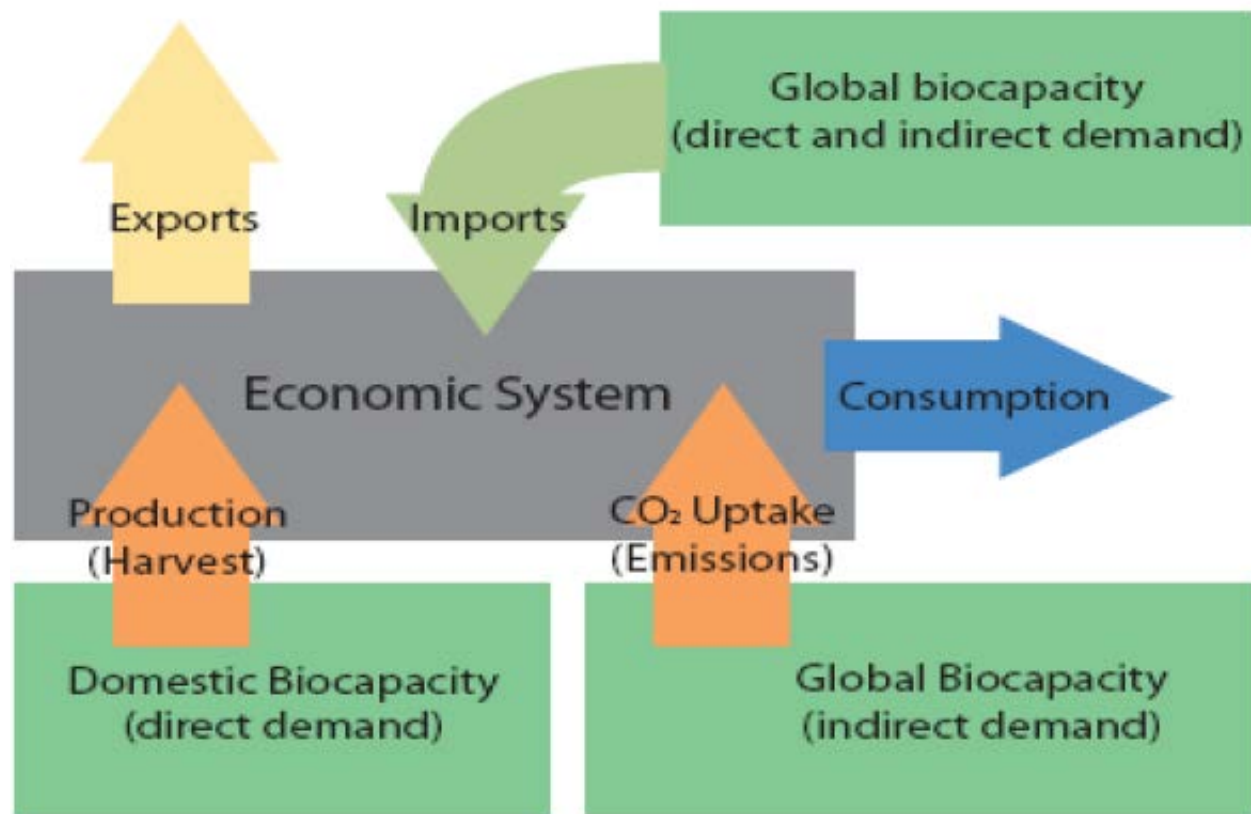
Input variable: flow of resource used by humans

From FLOW to AREA :

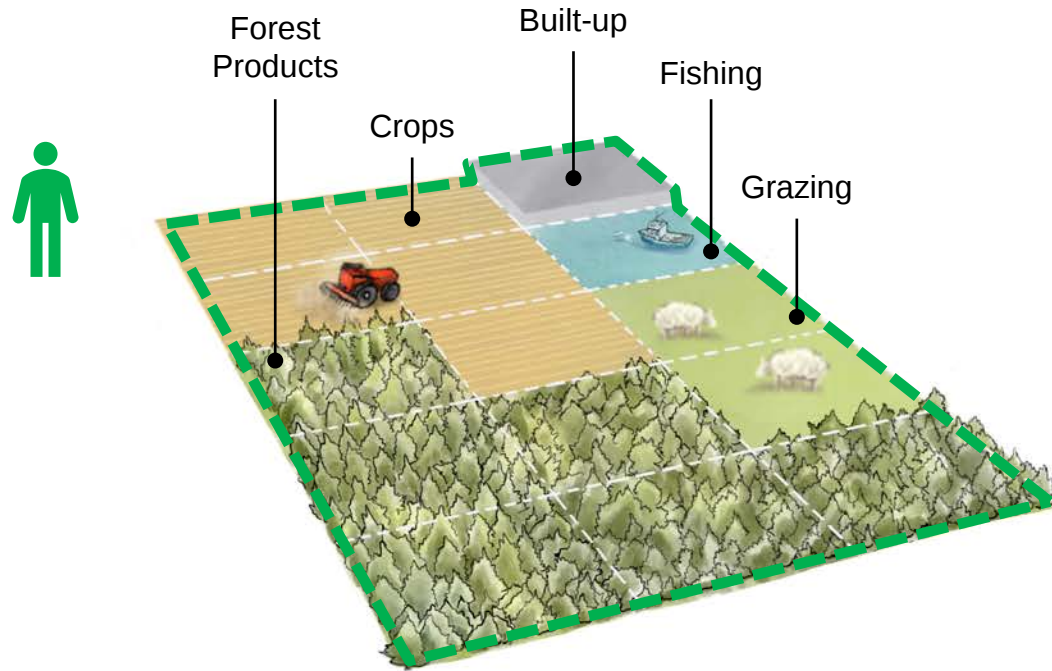
- Y_N is used to convert the consumption of a resource flow into the correspondent amount of area locally required to produce that flow
- YF is used to scale national to world average productivity for a given land use type
- EQF is used to scale world average productivity for a given land type to gha.



$$EF_C = EF_P + EF_I - EF_E$$

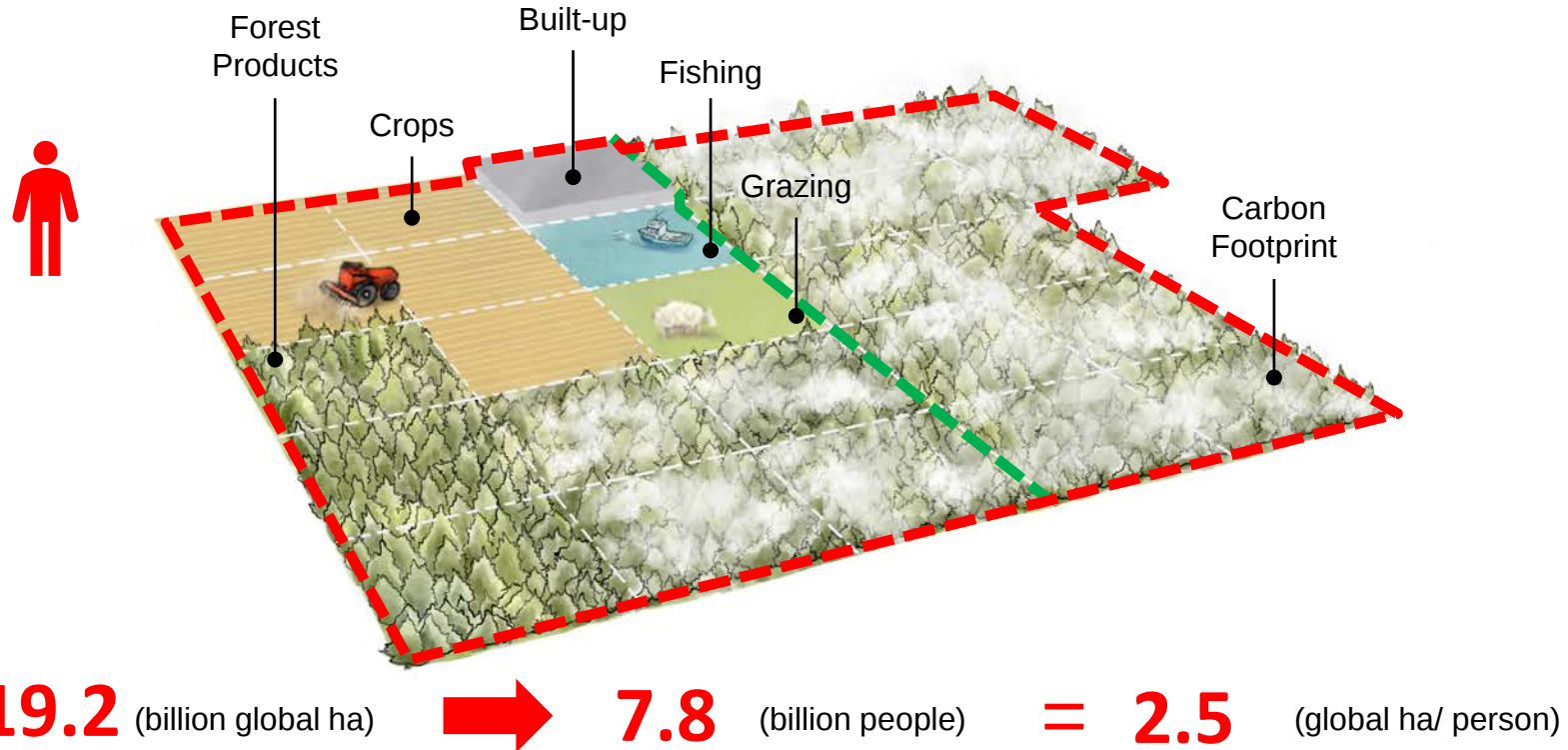


Our biocapacity per person in the world (2020)

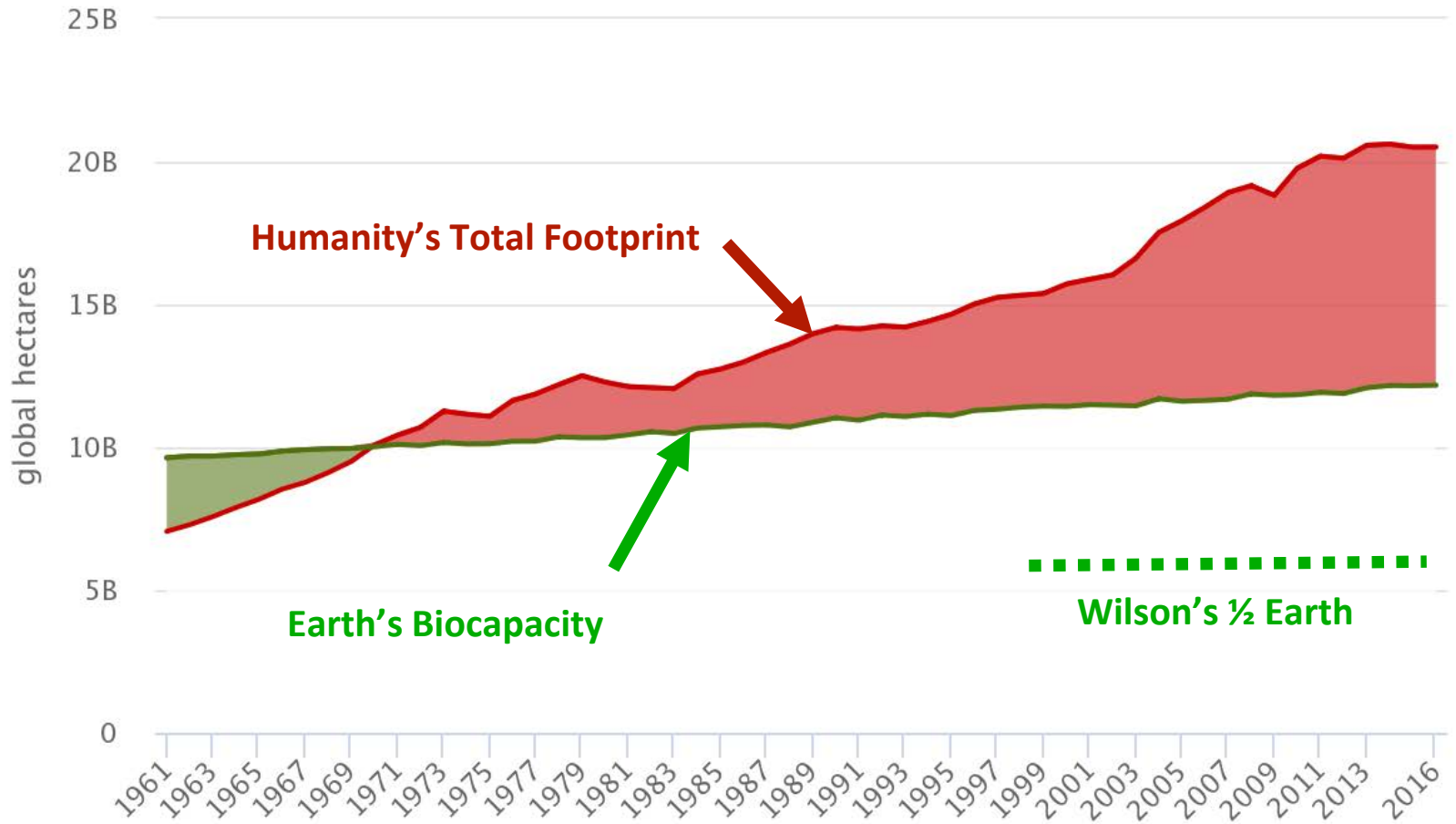


12.3 (billion ha)  **7.8** (billion people) = **1.6** (global ha/ person)

Our global Ecological Footprint per person (2020)



World

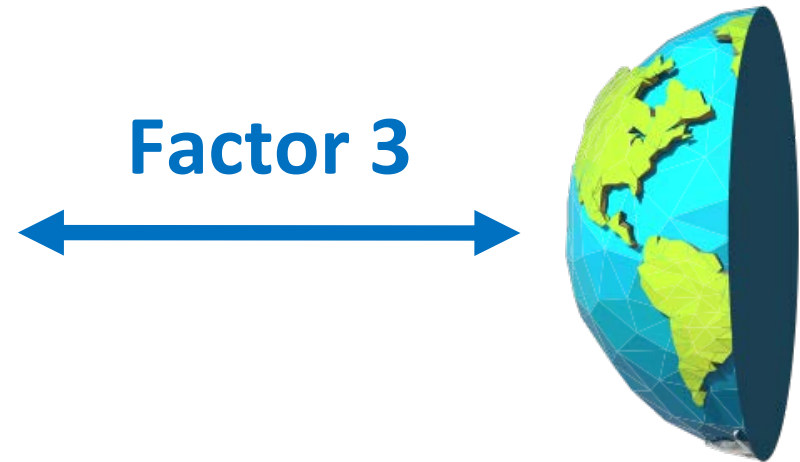


Demand on Regeneration

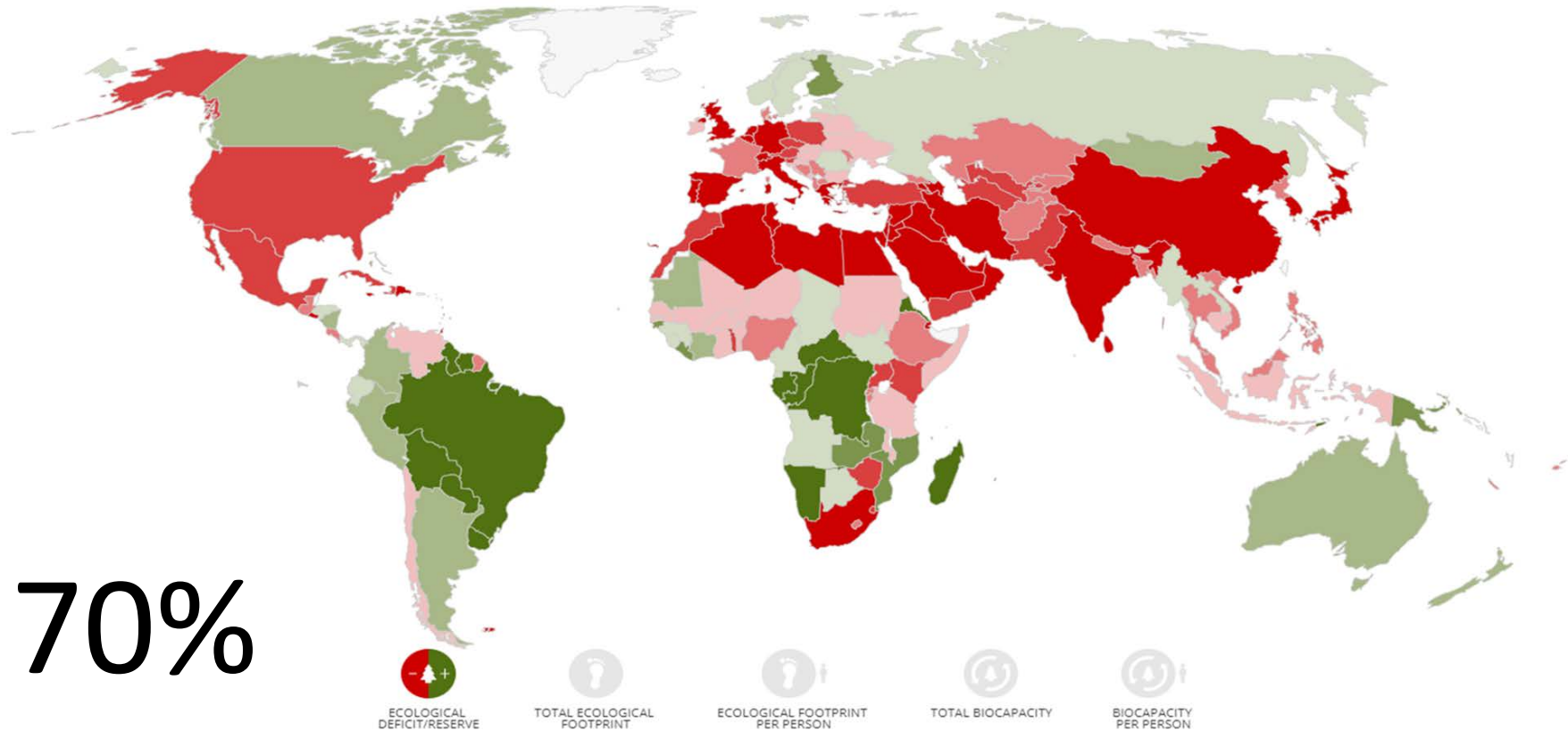
- Current use:
1.56 Earths



- Prof. E.O Wilson's goal:
“Half-Earth” to keep 85%
of biodiversity:



70%



ECOLOGICAL DEFICIT/RESERVE

An ecological deficit occurs when the [Ecological Footprint](#) of a population exceeds the [biocapacity](#) of the area available to that population. A national ecological deficit means that the nation is importing biocapacity through trade, liquidating national ecological assets or emitting carbon dioxide waste into the atmosphere. An ecological reserve exists when the biocapacity of a region exceeds its population's Ecological Footprint.

BIOCAPACITY CREDITORS

BIOCAPACITY GREATER THAN FOOTPRINT

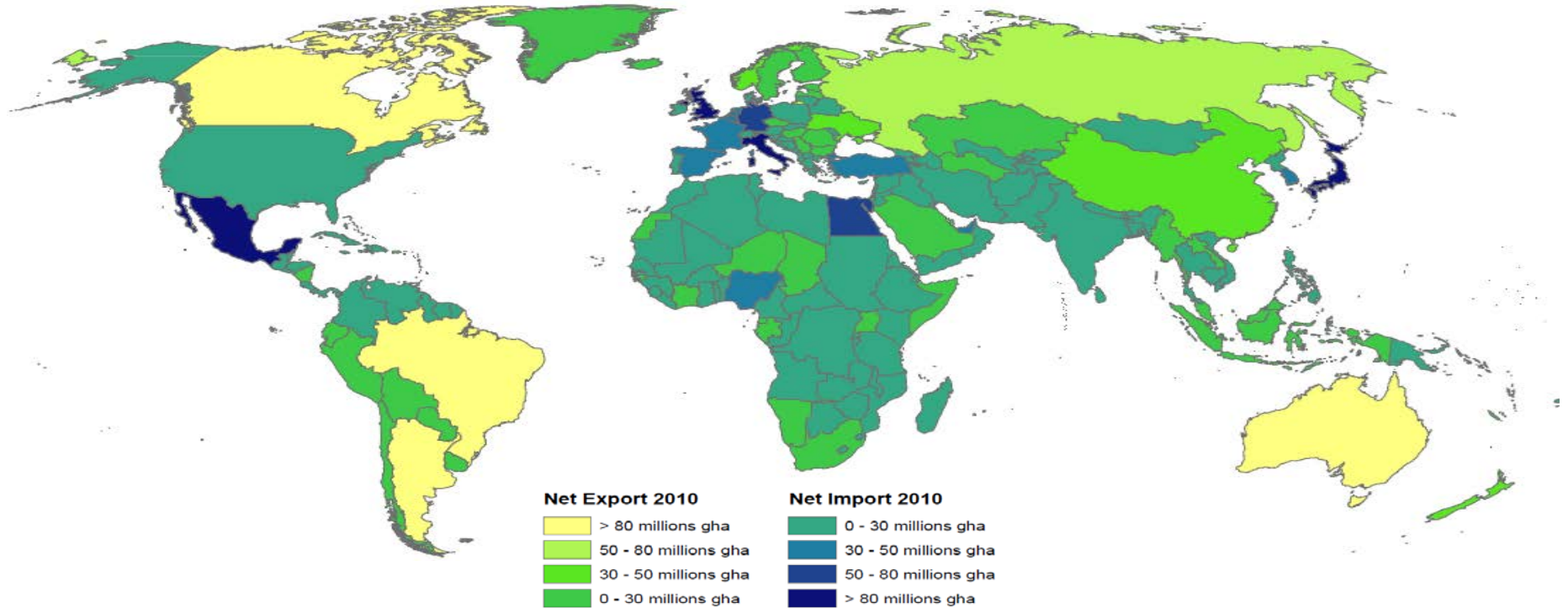


BIOCAPACITY DEBTORS

FOOTPRINT GREATER THAN BIOCAPACITY



Net biocapacity **Importer/**Exporter



Countries are highly interconnected and depend on each other

Ecological Footprint flows around the world

Cropland
Footprint



Fish
Footprint



Forest
Footprint

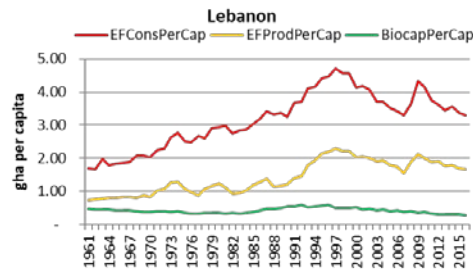
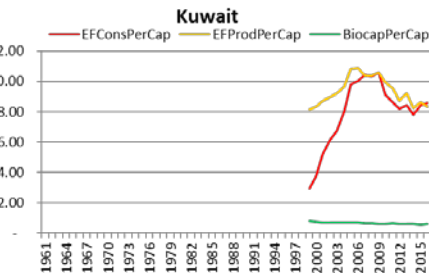
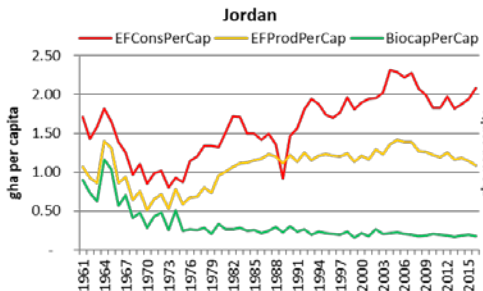
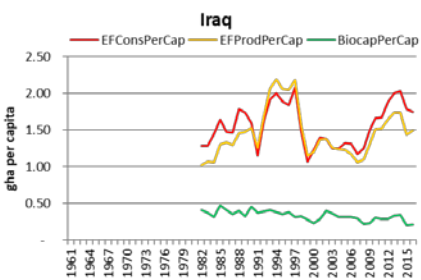
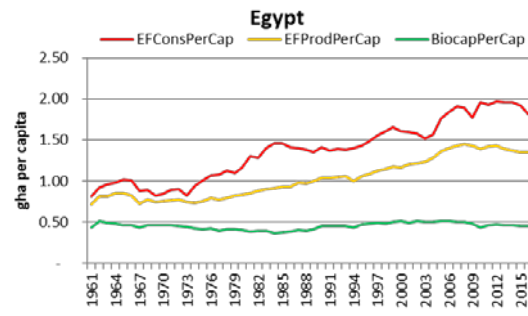
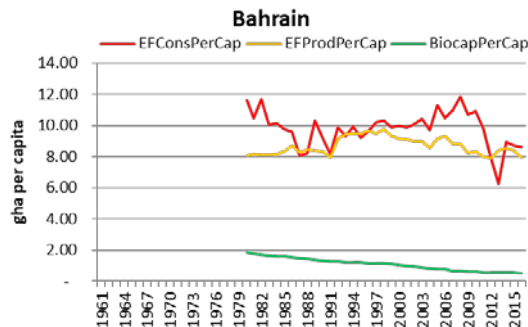
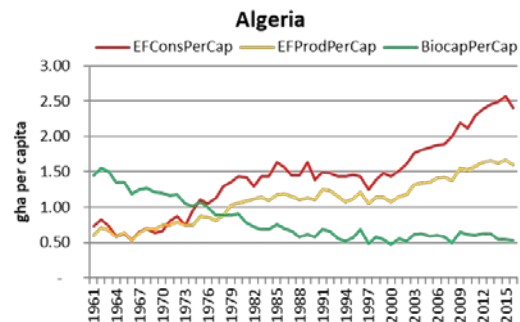


Grazing
Footprint

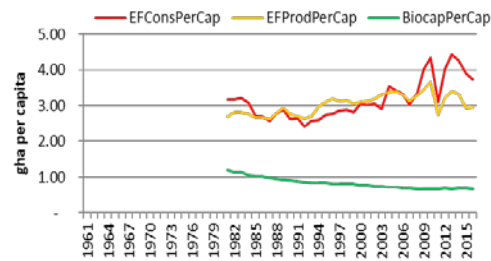


Source: Lazarus et al, 2015

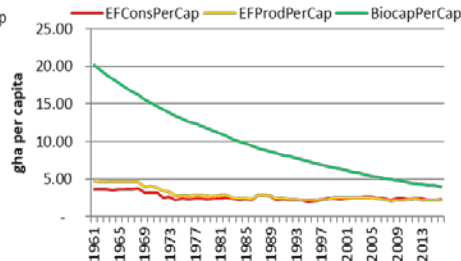
Ecological Footprint trends in the Arab Region



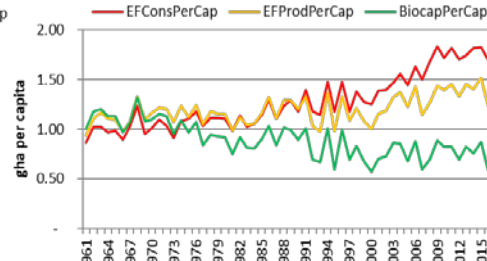
Libyan Arab Jamahiriya



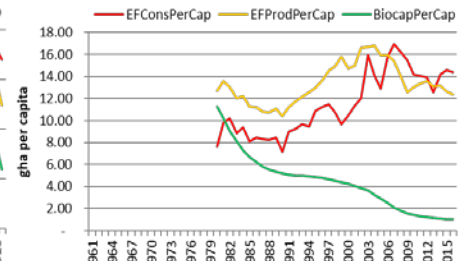
Mauritania



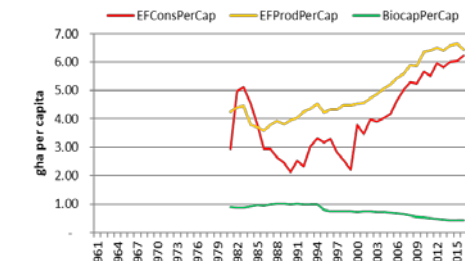
Morocco



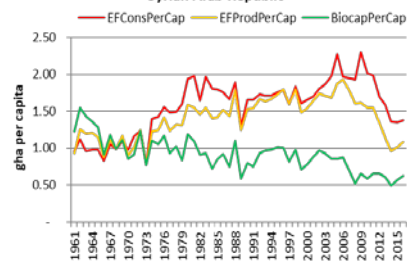
Qatar



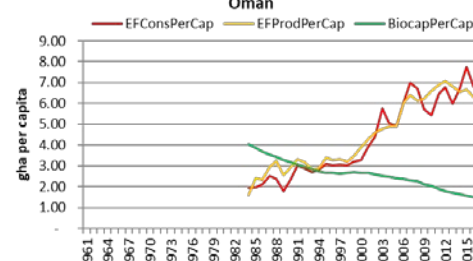
Saudi Arabia



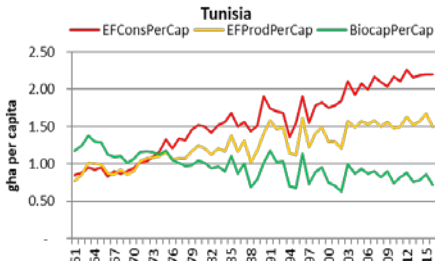
Syrian Arab Republic



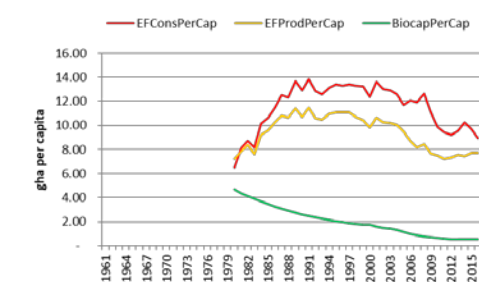
Oman



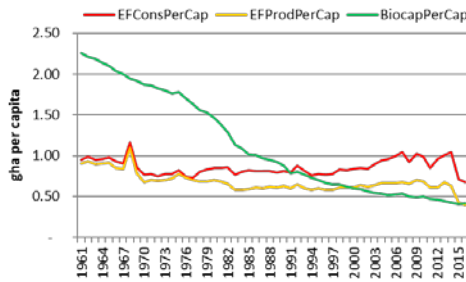
Tunisia



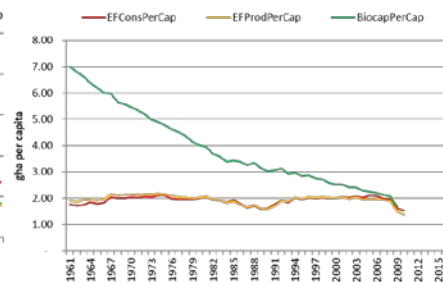
United Arab Emirates



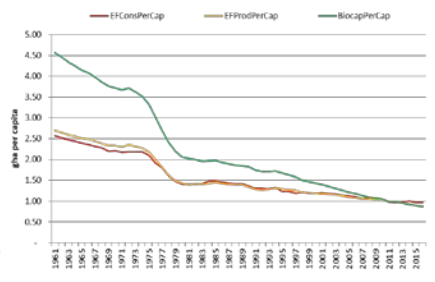
Yemen



Sudan

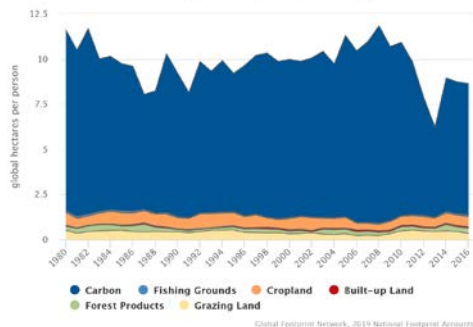


Somalia

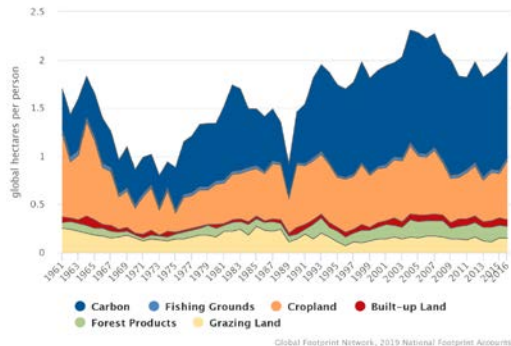


Ecological Footprint trends in the Arab Region

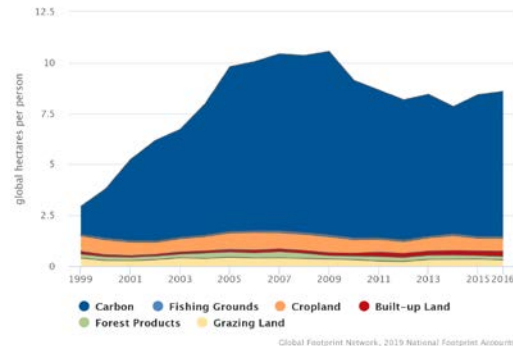
Bahrain Ecological Footprint by Land Type



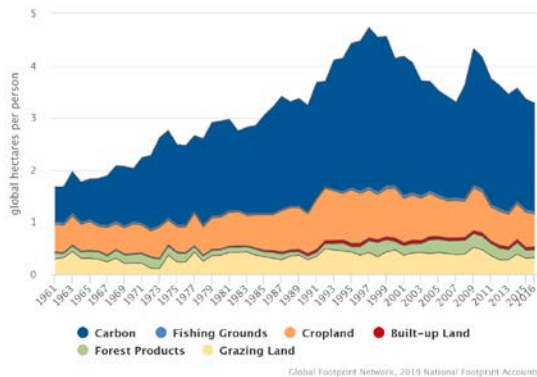
Jordan Ecological Footprint by Land Type



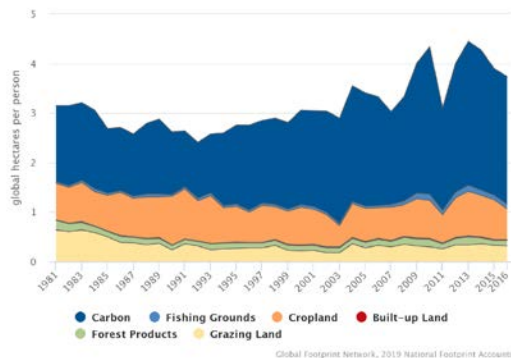
Kuwait Ecological Footprint by Land Type



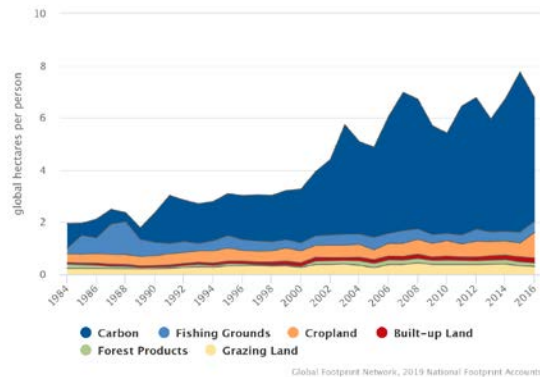
Lebanon Ecological Footprint by Land Type



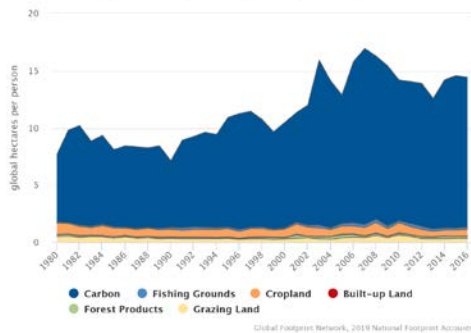
Libya Ecological Footprint by Land Type



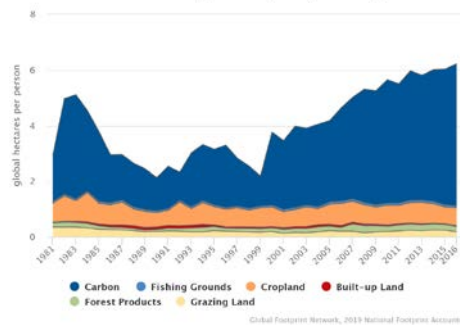
Oman Ecological Footprint by Land Type



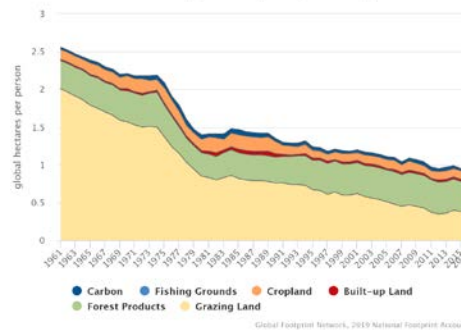
Qatar Ecological Footprint by Land Type



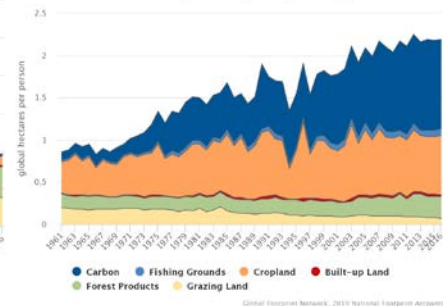
Saudi Arabia Ecological Footprint by Land Type



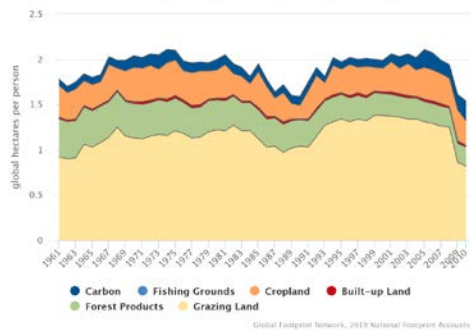
Somalia Ecological Footprint by Land Type



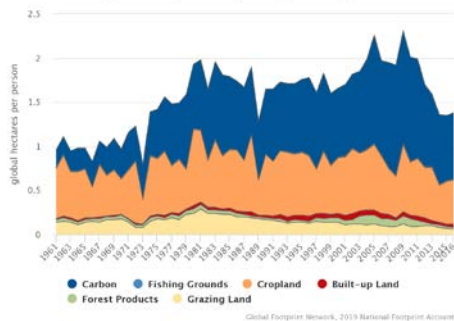
Tunisia Ecological Footprint by Land Type



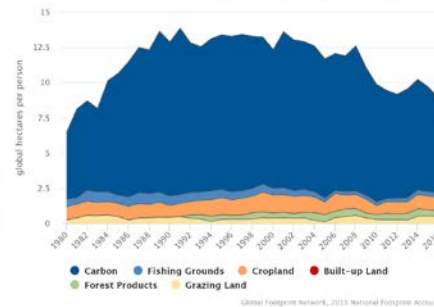
Sudan (former) Ecological Footprint by Land Type



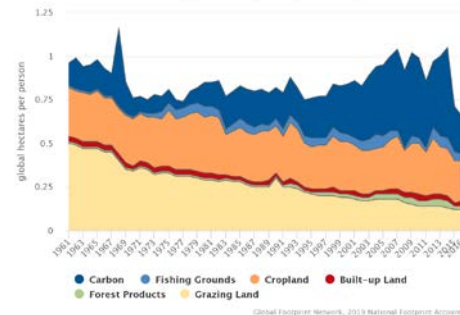
Syria Ecological Footprint by Land Type



United Arab Emirates Ecological Footprint by Land Type



Yemen Ecological Footprint by Land Type





Conclusions: how EF informs progresses on SDG12

- EF allows comparing the impact of a country's production and consumption activities vs. the ecological budget available (globally or nationally).
- It offers a framework to assess the **appropriation of ecological assets** due to both **production and consumption (PC) activities** thus offering a way to track progresses on **SDG12**
- It also allows comparing the impact of PC activities against the regeneration of the planet thus **complementing** the “**efficiency**” side of human PC activities with the “**one-planet-consistency**” side (whether they fit within planetary limits)
- EF clearly shows that **overall, the human enterprise is operating well beyond safe planetary limits**
- The same holds true for several **Arab countries**



Conclusions: how EF informs progresses on SDG12

- At country level, EF accounting allows connecting the location of resource consumption to those of resource production thus shedding light on the **teleconnections of our economies** and their **associated environmental externalities**.
- Comparing production Footprint vs. local biocapacity tells us about the extra pressure that economic activities place on the ecosystems of a country, thus representing an **indicator of direct (anthropogenic) drivers** of change in the state of biodiversity and ecosystems functioning (**IPBES Core Indicator**)
- Ecological Footprint helps track the underlying drivers of biodiversity loss (**C indicator for the Aichi Target 4**)



Key results by country available on public data platform

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